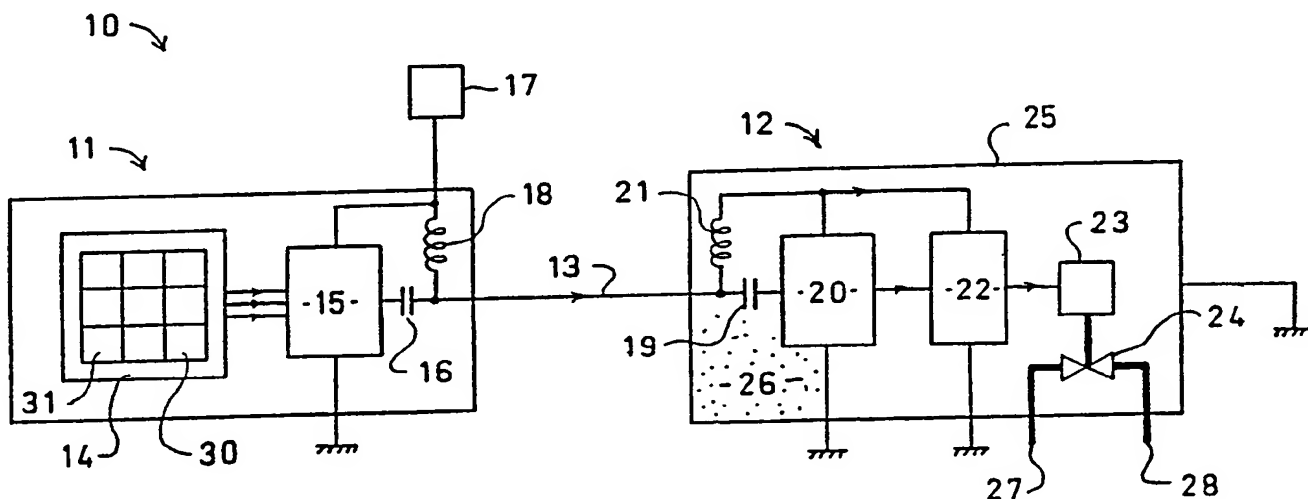


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(54) Title: SECURITY APPARATUS**(57) Abstract**

Security apparatus (10) for immobilising a vehicle is disclosed in which a password or security number is entered into a keypad (14) and encoded by a tone encoder (15). The tone-encoded signal is transmitted along a wire (13) to an enclosure (25) in which a tone decoder (20) and a fuel solenoid valve (23) energized by the tone decoder (20) are encapsulated. The fuel solenoid valve (23) opens only when a security number which produces a tone-encoded signal to which the tone-decoder (20) will respond has been entered into the keyboard (14). The security apparatus (10) may be disabled in a service mode permitting the vehicle to be operated without providing a password to service personnel, and the mode in force is stored in non-volatile memory, allowing the power supply (17) to be disconnected for servicing purposes without the security apparatus (10) reverting to security mode.

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"SECURITY APPARATUS"

-- BACKGROUND OF THE INVENTION --

This invention relates to security apparatus.

This invention has particular but not exclusive application to security from theft for motor vehicles, and for illustrative purposes reference will be made to such application. However, it is to be understood that this invention could be used in other applications, such as the distribution of dangerous chemicals.

-- DESCRIPTION OF THE PRIOR ART --

The theft of motor vehicles is a serious problem in many countries, and many security accessories have been devised for vehicles to deter thieves, or to increase the time required to steal a vehicle to an unacceptable value. Such systems usually function by denying access to the interior of the vehicle, or by de-activating some essential component of the vehicle. Such security accessories are often fitted with tumbler-type locks, and necessitate the use of supplementary keys in addition to the normal access and ignition keys. Many such accessories function by isolating the power supply to electrical components, and can be defeated by electrically bypassing the isolation equipment to energise the electrical component independently of the security accessory.

-- SUMMARY OF THE PRESENT INVENTION --

The present invention aims to alleviate the above disadvantages and to provide security apparatus which will be reliable and efficient in use. Other objects and advantages of this invention will hereinafter become apparent.

With the foregoing and other objects in view, this invention in one aspect resides broadly in security apparatus for controlling electrically-energized apparatus, said security apparatus including:-
encoding means accessible to an operator for producing an encoded electrical signal;

decoding means adjacent said electrically-energized apparatus for decoding said encoded signal and operating said electrically-energized apparatus in accordance with the content of said encoded signal; and

5 transmission means for transmitting said encoded signal between said encoding means and said decoding means.

Preferably, the decoding means and the electrically-energized apparatus are located adjacent one another or mounted in juxtaposition, and are placed in a security
10 enclosure such that access to the energising output from the decoding means and the energising input to the electrically-energized apparatus are not readily accessible for the purpose of bypassing them whereby the electrically-energized apparatus may be energized independently of the security
15 apparatus. The security enclosure may include encapsulation in a settable plastics material such as epoxy resin, or may include a robust enclosure such that access to the decoding means and the electrically-energized apparatus is limited. If desired, however, access to the energising connection
20 between the decoding apparatus and the electrically-energized apparatus may be limited by placing the decoding apparatus and the electrically-energized apparatus in a hidden location or a confined space. The decoding means may be provided with an auxiliary output energized in a similar manner to the
25 output controlling the electrically-energized apparatus whereby auxiliary electrically-energized apparatus may be selectively energized, and the auxiliary output may be brought outside of the security enclosure. Suitably, the auxiliary output is operated by the decoding means
30 independently of the output controlling the electrically-energized apparatus such that independent energization of the auxiliary output will not operate the electrically-energized apparatus.

The encoding means may have as its input a coded key reader such as a magnetic card reader or a conventional mechanical key-operated lock. Preferably, however, the input to the encoding means is in the form of a data-entry keypad, such as a numeric keypad whereby a selected security number may be utilised to operate the security apparatus. The encoding means may encode the input into an encoded electrical signal such as a digital pulse train for transmission along wires to the decoding means. However, it is preferred that the encoded electrical signal be in the form of a tone-encoded signal, such as a signal in which the keys of the keyboard are associated with the production by the encoding apparatus of respective tones of different frequency, which may be transmitted to the decoding means either sequentially or simultaneously in superimposed form along a single or dual-wire transmission means for simplicity. Tone encoding has the advantage of greatly reduced sensitivity to electrical interference in a noisy electrical environment such as an automotive electrical system, compared to digital pulse encoding. The tone-encoded signal may be transmitted to the decoding means by separate dedicated wires, or if desired it may be superimposed on DC or AC power transmission wires. The encoding means and the decoding means may be connected to the power transmission wires by frequency-selective isolating means such as capacitors, and the tone encoded signal may be confined to selected regions of the power transmission wires by the use of frequency-selective components such as inductors. Suitably, selected inductors and capacitors may be included within the encoding and decoding means. The technique of superimposing control signals on power wiring is of particular benefit when it is desired to fit a security apparatus to an existing vehicle with minimal additional

wiring.

5 The decoding means may be used to control the spark
ignition system of a vehicle, energising the spark ignition
system only if a selected combination of tones is transmitted
by the encoding means. Other automotive electrically-
energized apparatus which may be controlled by decoding means
may include a fuel pump and a starter motor solenoid or
relay. It is preferred, however, that the decoding system
10 control a fuel flow solenoid valve in the fuel delivery pipe
to the engine whereby fuel will be supplied to the engine
only after a selected tone-encoded signal has been
transmitted to the decoding means. The fuel flow solenoid
valve may be of a type which remains open whenever electrical
power is supplied thereto, whereby interruption of the
15 energising output from the decoding means will cause the fuel
flow solenoid valve to close, or it may be of a type which
requires energization to remain closed, whereby failure of
the security apparatus to operate may not prevent the engine
from operating. Alternatively, the fuel flow solenoid valve
20 may be formed with locking means whereby it may be locked in
the open or closed positions in the absence of electrical
energization such that a constant electrical current drain is
not necessary. The locking means may take any desired form,
such as a ball detent or an over-centre toggle mechanism.

25 The encoding means may include input limiting means for
restricting the number of retries permissible for entry of
the correct input. For instance, the limiting means may
require the encoding means to be reset after an incorrect
input by switching the power to the encoding means off and
30 then on, and may also prevent operation of the encoding means
for a predetermined period, for instance twenty minutes,
after a predetermined number, say three to five, of incorrect
inputs or unsuccessful retries, such that an unauthorized

user attempting to operate the electrically-energised apparatus by trial-and-error input would be unable to try a significant number of different codes within a reasonable time, while permitting a degree of inaccuracy of input entry by an authorised operator.

The encoding means may be provided with visual or audible alarm means such as a flashing light or a buzzer and the alarm means may be programmed to operate when the security apparatus is holding the electrically-energized apparatus in a particular state such as the inoperative state such that unauthorized operators may be made aware of the presence of the security apparatus. The encoding means may also be provided with a "service" mode including the facility for selectively enabling or disabling the operation of the security apparatus in its "security" mode by entering a special code or by pressing a particular code key after entering a valid security number whereby the security apparatus may be temporarily bypassed for servicing or test purposes. Alarm means such as a flashing light may be provided to indicate that the security apparatus is in the service mode. Mode storage means such as non-volatile memory in a form such as EEPROM (Electrically-Eraseable Programmable Read-Only Memory) or battery or capacitor-backed RAM may be provided for retaining mode data during disconnection of power from the security apparatus, such that the security apparatus may remain in the same mode after reconnection of power following service operations as it was before disconnection of power. This feature ensures that the security apparatus cannot be disabled by temporary disconnection of the power, while ensuring that the security apparatus will remain in service mode until such mode is disabled

If desired, a plurality of decoding means may be

provided, each associated with an electrically-energized apparatus. In an automotive application, decoding means may be provided associated with a fuel flow solenoid valve, electronic fuel injection apparatus, fuel pump apparatus, starter motor solenoid, and, if desired, the spark ignition system.

In a further aspect, this invention resides in a method of controlling the operation of electrically-energized apparatus including:-

- 10 providing encoding means for electrically encoding an entered security code to produce an encoded electrical signal; providing decoding means for decoding an electrical signal and producing a control output signal for operating said electrical apparatus, said decoding means and said electrical
- 15 apparatus being disposed adjacent one another within a security enclosure; providing transmission means for transmitting said encoded electrical signal between said encoding means and said decoding means; and
- 20 operating said security apparatus by entering a security code into said encoding means which is recognizable by said decoding means and which causes said decoding means to operate said electrically-energized apparatus.

-- BRIEF DESCRIPTION OF THE DRAWINGS --

- 25 In order that this invention may be more easily understood and put into practical effect, reference will now be made to the accompanying drawings which illustrate a preferred embodiment of the invention, wherein:-

FIG. 1 is a block diagram of the security apparatus.

- 30 -- DESCRIPTION OF THE PREFERRED EMBODIMENT --

The security apparatus 10 shown in FIG. 1 includes a transmitter assembly 11 mounted near the driving position of a motor vehicle and joined to an operating assembly 12 near

the fuel delivery line by a signal wire 13. A numeric keypad 14 in the transmitter assembly 11 has its output connected to a tone encoder 15 which produces selected audio frequency tones corresponding to respective keys in the keypad 14.

5 The output from the tone encoder 15 is connected by the signal wire 13 to the input of the tone decoder 20, and any DC signals or power present on the signal wire 13 is blocked from the tone encoder 15 and the tone decoder 20 by blocking capacitors 16. DC electric power is supplied to the
10 transmitter assembly 11 and the operating assembly 12 from a power supply 17 in the form of a battery and/or generator. If desired, DC power may be supplied to the operating assembly through the signal wire 13 from the transmitter assembly, in which case the signal wire 13 is connected to
15 the power supply 17 and the power input to the operating assembly 12 through series inductors which block the loss of audio tone current into the electrical system of the vehicle.

Within the operating assembly 12, the output of the tone decoder 20 is fed to the control port of the switch 22, the
20 output of which drives the solenoid coil 23 which in turn controls the fuel valve 24.

The operating assembly 12 is mounted within an enclosure 25 which is filled with encapsulant 26. The exposed fuel feed pipe 27 and fuel intake pipe 28 may be connected into
25 the fuel feed system of the vehicle.

When an operator desires to start a vehicle equipped with a security apparatus 10 according to this invention, he turns on the ignition switch 17, and then enters through the keypad 14 a security code number for which the security
30 apparatus 10 has been programmed. The tone encoder 15 generates the combination of tones corresponding to the entered security code number and the tones are transmitted along the signal wire 13 to the tone decoder 20.

If the tones are a combination for which the tone decoder 20 has been programmed, it produces an output which operates the switch 22, feeding current from the power supply 17 to the solenoid coil 23 to open the fuel valve 24, and the vehicle motor may be started.

If the tones are not a combination for which the tone decoder 20 has been programmed, it will not energise the switch 22, and the fuel valve 24 will remain closed, preventing the vehicle motor from starting. The solenoid coil 23 cannot be energized by altering wiring external to the enclosure 25, as the switch 22 can only be energized by the application of a correct tone combination to the tone decoder 20.

If it is desired that the vehicle be left in the care of personnel such as repair personnel without disclosing the security code number, the "service" key 30 on the keypad 14 is pressed after entering the valid security code number. This action places the security apparatus 10 in a disabled state such that the vehicle may be started repeatedly without the necessity for entering the security code number. The security apparatus may be re-activated by pressing the "re-arm" key 31 on the keypad 14. If the power supply 17 is disconnected while the security apparatus 10 is in the service mode, data stored in non-volatile memory within the security apparatus 10 re-initializes the latter in the service mode upon reconnection of the power supply 17, ensuring that the security apparatus does not default to the security mode with consequent inconvenience to service personnel.

It will of course be realised that while the above has been given by way of illustrative example of this invention, all such and other modifications and variations thereto as would be apparent to persons skilled in the art are deemed to

fall within the broad scope and ambit of this invention as is defined in the appended claims.

-- CLAIMS --

1. Security apparatus for controlling electrically-energized apparatus, said security apparatus including:-
encoding means accessible to an operator for producing an encoded electrical signal;
decoding means adjacent said electrically-energized apparatus for decoding said encoded electrical signal and operating said electrically-energized apparatus in accordance with the content of said encoded signal; and
transmission means for transmitting said encoded signal between said encoding means and said decoding means.
2. Security apparatus according to Claim 1, wherein said decoding means and said electrically-energized apparatus are disposed within a security enclosure.
3. Security apparatus according to Claim 2, wherein said decoding means and said electrically-energized apparatus are juxtapositioned and embedded within an encapsulating material.
4. Security apparatus according to Claim 1, wherein said encoding means is in the form of a data-entry keypad.
5. Security apparatus according to Claim 1, wherein said encoding means is a magnetic card reader.
6. Security apparatus according to Claim 1, wherein said encoded signal is a digital pulse train.
7. Security apparatus according to Claim 1, wherein said encoded signal is in the form of a tone-encoded signal.

8. Security apparatus according to Claim 1, wherein said transmission means includes power transmission wires used for electrical power supply and wherein said encoding means and said decoding means are connected to said power transmission wires with frequency-selective isolating means.

9. Security apparatus according to Claim 1, wherein said transmission means includes frequency-selective isolation means for confining said encoded signal to selected regions of the power transmission wires.

10. Security apparatus according to Claim 1, wherein said decoding means is provided with an independent auxiliary control output.

11. Security apparatus according to Claim 1, wherein there is provided a plurality of electrically-energized apparatus, each associated with a respective decoding means.

12. Security apparatus according to Claim 1, wherein said electrically-energized apparatus includes a fuel flow solenoid valve.

13. Security apparatus according to Claim 1, wherein said electrically-energized apparatus includes a fuel flow solenoid valve and fuel-injection apparatus.

14. Security apparatus according to Claim 1, wherein said electrically-energized apparatus includes a fuel flow solenoid valve and automotive ignition apparatus.

15. Security apparatus according to Claim 1, wherein said encoding means is programmed to include a security mode in

which said security apparatus requires a code entry for operation and a service mode in which operative functioning of said security apparatus is disabled, said service mode being selected by the entry of a selected series of security codes.

16. Security apparatus according to Claim 15, wherein there is provided non-volatile storage of the mode state of said security apparatus during periods of power disconnection therefrom.

17. Security apparatus according to Claim 12, wherein said fuel flow solenoid valve includes decoding means for opening said fuel solenoid valve and locking means for holding said fuel solenoid valve in an open position.

18. A method of controlling the operation of electrically-energized apparatus including:-
providing encoding means for electrically encoding an entered security code to produce an encoded electrical signal;
providing decoding means for decoding an electrical signal and producing a control output signal for operating said electrical apparatus, said decoding means and said electrical apparatus being disposed adjacent one another within a security enclosure;
providing transmission means for transmitting said encoded electrical signal between said encoding means and said decoding means; and
operating said security apparatus by entering a security code into said encoding means which is recognizable by said decoding means and which causes said decoding means to operate said electrically-energized apparatus.

13

19. Security apparatus substantially as herein described with reference to the accompanying drawings.

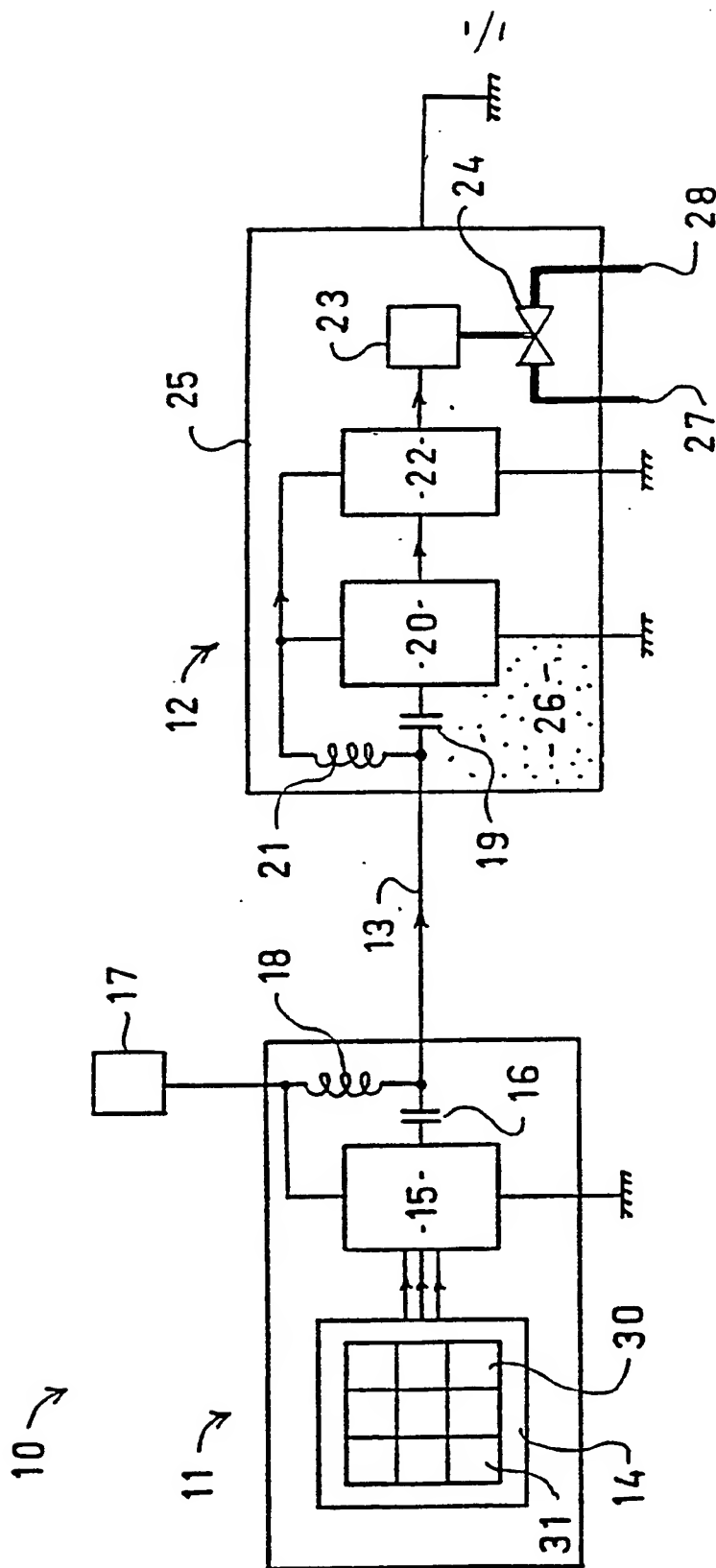


FIG. 1

INTERNATIONAL SEARCH REPORT

International Application No. **PCT/AU 89/00068**

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) ⁴ According to International Patent Classification (IPC) or to both National Classification and IPC <div style="text-align: center; font-size: 1.2em;">Int. Cl. ⁴ G08B 29/00, B60R 25/04</div>																							
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III. DOCUMENTS CONSIDERED TO BE RELEVANT ⁹ <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 10%; font-size: 0.8em;">Category [*]</th> <th style="width: 60%; font-size: 0.8em;">Citation of Document, ¹¹ with indication, where appropriate, of the relevant passages ¹²</th> <th style="width: 30%; font-size: 0.8em;">Relevant to Claim No. ¹³</th> </tr> </thead> <tbody> <tr> <td style="text-align: center;">P,A</td> <td>GB,A, 2200086 (CHANDLER) 27 July 1988 (27.07.88)</td> <td></td> </tr> <tr> <td style="text-align: center;">P,A</td> <td>US,A, 4794268 (NISSAN) 27 December 1988 (27.12.88)</td> <td></td> </tr> <tr> <td style="text-align: center;">X</td> <td>FR,A, 2592347 (RENAULT) 3 July 1987 (03.07.87)</td> <td style="text-align: center;">(1)</td> </tr> <tr> <td style="text-align: center;">X</td> <td>US,A, 4688036 (NISSAN) 18 August 1987 (18.08.87)</td> <td style="text-align: center;">(1-17)</td> </tr> <tr> <td style="text-align: center;">X</td> <td>US,A, 4383242 (TMX SYSTEMS LTD) 10 May 1983 (10.05.83)</td> <td style="text-align: center;">(1,18)</td> </tr> <tr> <td style="text-align: center;">X</td> <td>US,A, 4288778 (ZUCKER) 8 September 1981 (08.09.81)</td> <td style="text-align: center;">(1,18)</td> </tr> </tbody> </table>			Category [*]	Citation of Document, ¹¹ with indication, where appropriate, of the relevant passages ¹²	Relevant to Claim No. ¹³	P,A	GB,A, 2200086 (CHANDLER) 27 July 1988 (27.07.88)		P,A	US,A, 4794268 (NISSAN) 27 December 1988 (27.12.88)		X	FR,A, 2592347 (RENAULT) 3 July 1987 (03.07.87)	(1)	X	US,A, 4688036 (NISSAN) 18 August 1987 (18.08.87)	(1-17)	X	US,A, 4383242 (TMX SYSTEMS LTD) 10 May 1983 (10.05.83)	(1,18)	X	US,A, 4288778 (ZUCKER) 8 September 1981 (08.09.81)	(1,18)
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